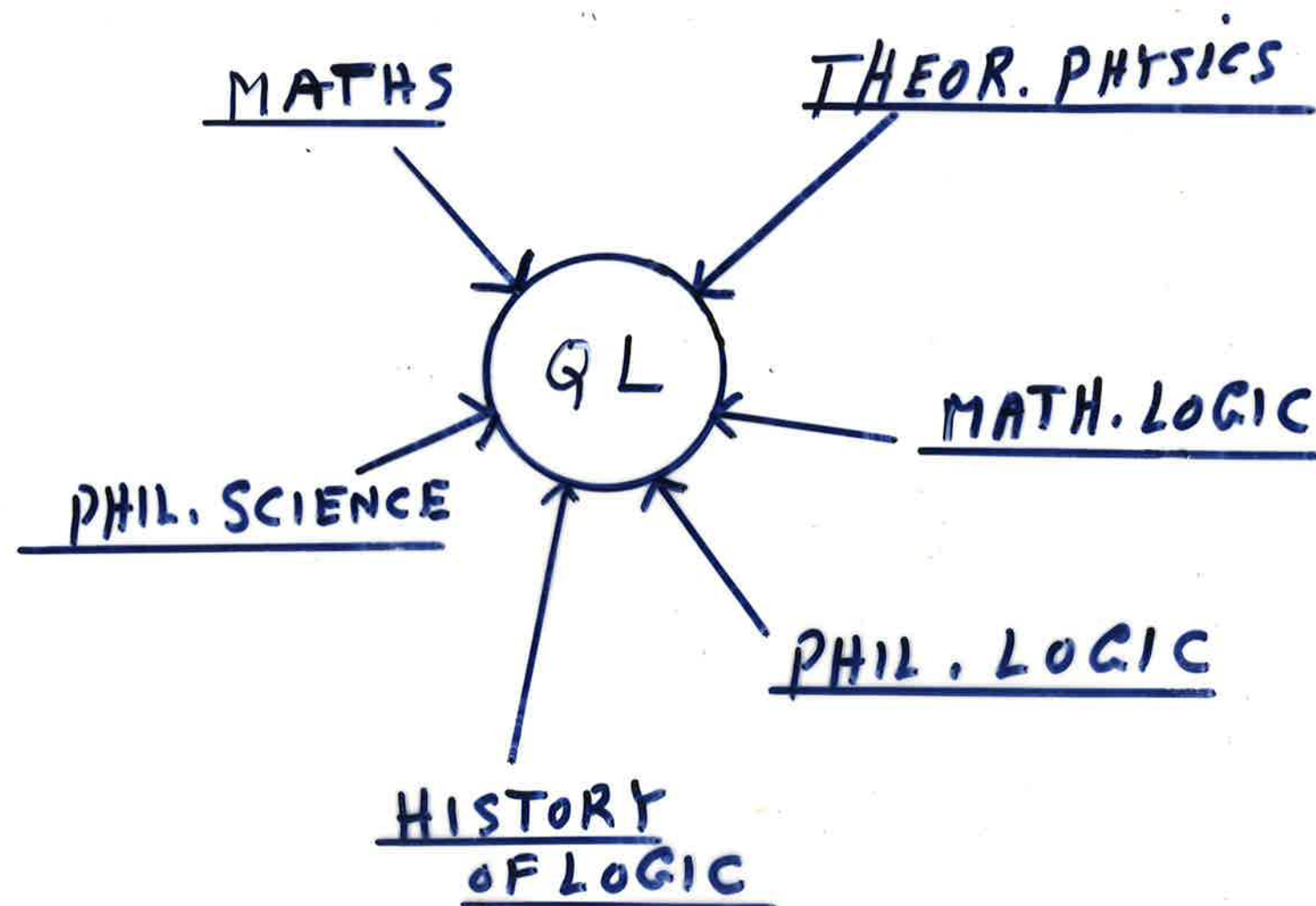
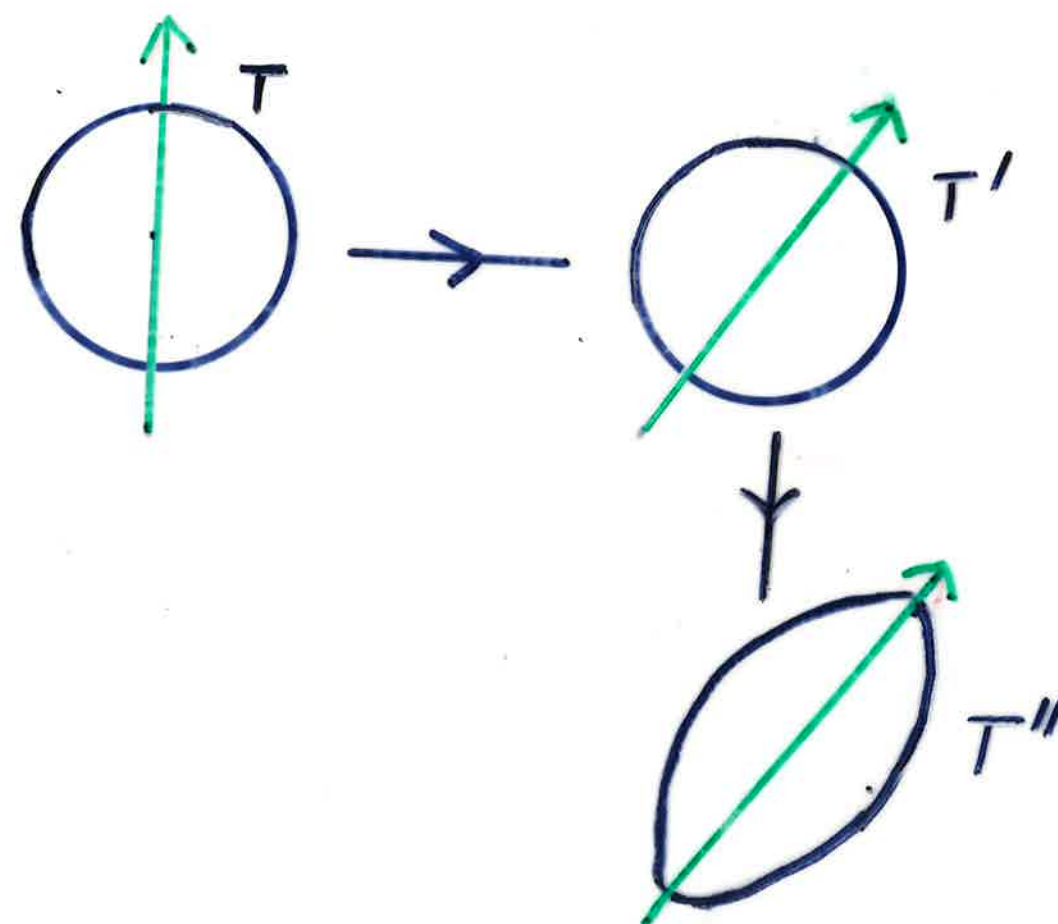


INPUTS TO QL.



2

REFORMULATION
AND 'STRETCHING'



HISTORICAL DEVELOPMENT of QL.

French Empiricist
School of Logic : Godeeth,
Bachelard etc

Many-Valued Logics

Technical development by
Lukasiewicz (1920) and Post (1921)

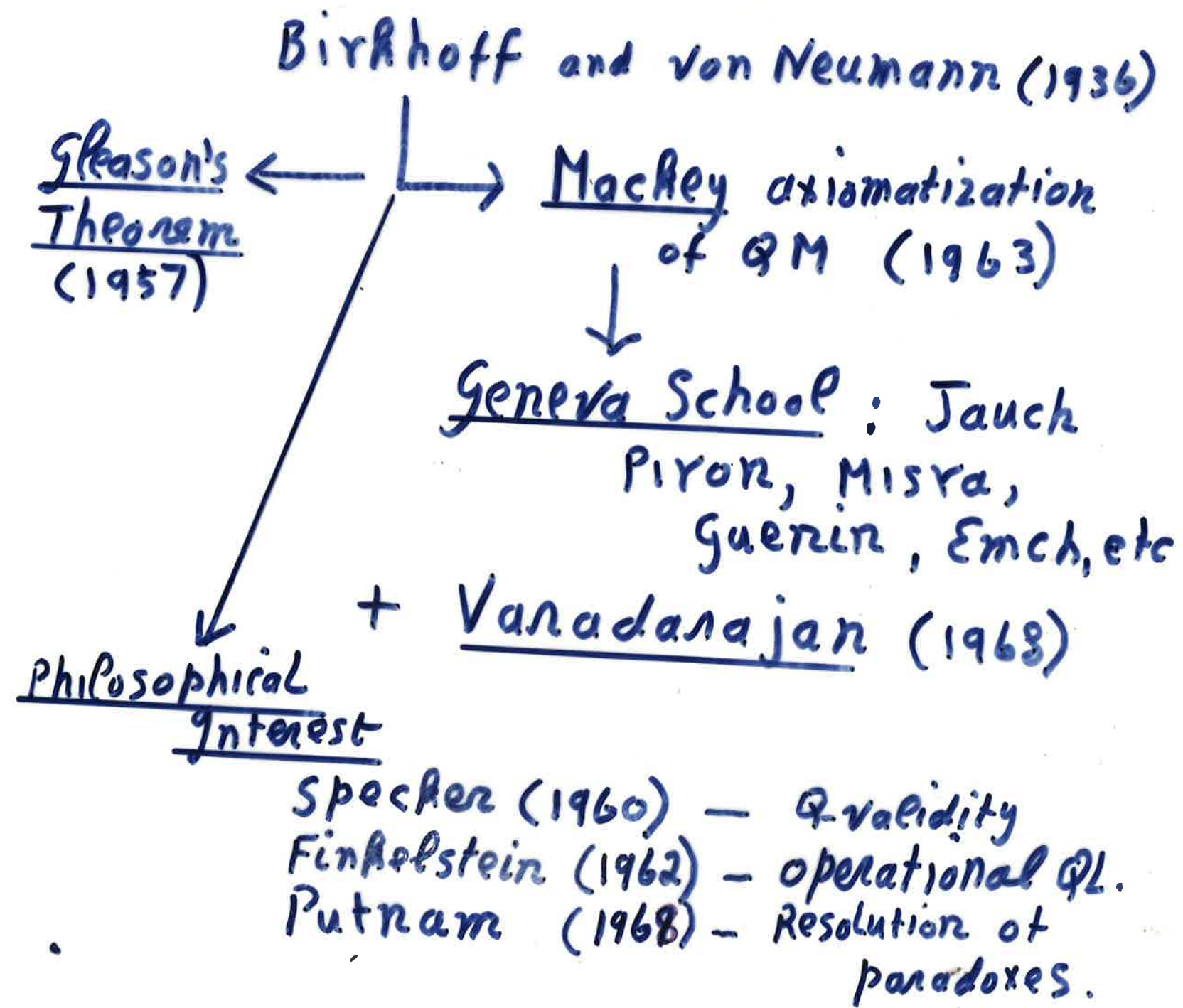
↳ Application to QM suggested
by Zawirski (1931)

3-Valued
QL.

↓ Destouches-Fevrier (1937)
Reichenbach (1944)

↓
Supported by Putnam (1957)

• Non-Distributive QL



• PUTNAM AND QUANTUM LOGIC

$$\frac{\text{Geometry}}{GR} = \frac{\text{Logic}}{QM}$$

$$\begin{array}{ccccc}
 L & + & P' & = & L' & + & P \\
 \text{old Logic} & & \uparrow & & \text{New} & & \uparrow \\
 & & \text{new physics} & & \text{Logic} & & \text{old Physics} \\
 & & (\text{paradoxes}) & & & & (\text{classical realism} \\
 & & & & & & \text{— no paradoxes})
 \end{array}$$

LOGIC IN CLASSICAL PHYSICS

Phase space of Universe is

$$\tilde{\Omega} = \prod_{\lambda \in I} \Omega_{\lambda}$$

I is set of all particles and fields

Elementary proposition q associates representative point of the Universe with subset Q of $\tilde{\Omega}$.

Compound propositions:

p or q associated with $P \cup Q$

p & q $P \cap Q$

$\sim p$ $C P$

Thus $\mathcal{O}(\tilde{\Omega})$ serves as characteristic algebra for CPC.

LOGIC AND SET THEORY

Set Theory based on Logic:

$$\tilde{A} = \{y : A(y)\}, \text{ etc.}$$

$$\tilde{A} \cup \tilde{B} \stackrel{\text{Df.}}{=} \{x : x \in \tilde{A} \vee x \in \tilde{B}\}$$

$$\tilde{A} \cap \tilde{B} \stackrel{\text{Df.}}{=} \{x : x \in \tilde{A} \wedge x \in \tilde{B}\}$$

$$C\tilde{A} \stackrel{\text{Df.}}{=} \{x : x \notin \tilde{A}\}$$

Logic based on Set Theory:

$$A(x) \vee B(x) \stackrel{\text{Df.}}{=} x \in [\tilde{A} \cup \tilde{B}]$$

$$A(x) \wedge B(x) \stackrel{\text{Df.}}{=} x \in [\tilde{A} \cap \tilde{B}]$$

$$\sim A(x) \stackrel{\text{Df.}}{=} x \in [C\tilde{A}]$$

PUTNAM AND THE PARADOXES ψ_n : Oscar has position n ϕ_s : Oscar has momentum s

$$S_1 : (\psi_1 \vee \psi_2 \dots \vee \psi_n) \wedge (\phi_1 \vee \phi_2 \dots \vee \phi_n)$$

$$S_2 : (\psi_1 \wedge \phi_1) \vee (\psi_1 \wedge \phi_2) \dots \vee (\psi_1 \wedge \phi_n)$$

$$(\psi_n \wedge \phi_1) \vee \dots \vee (\psi_n \wedge \phi_n)$$

$$\text{In C.L. } S_1 \equiv S_2,$$

$$\text{In Q.L. } S_1 \equiv I \wedge I = I$$

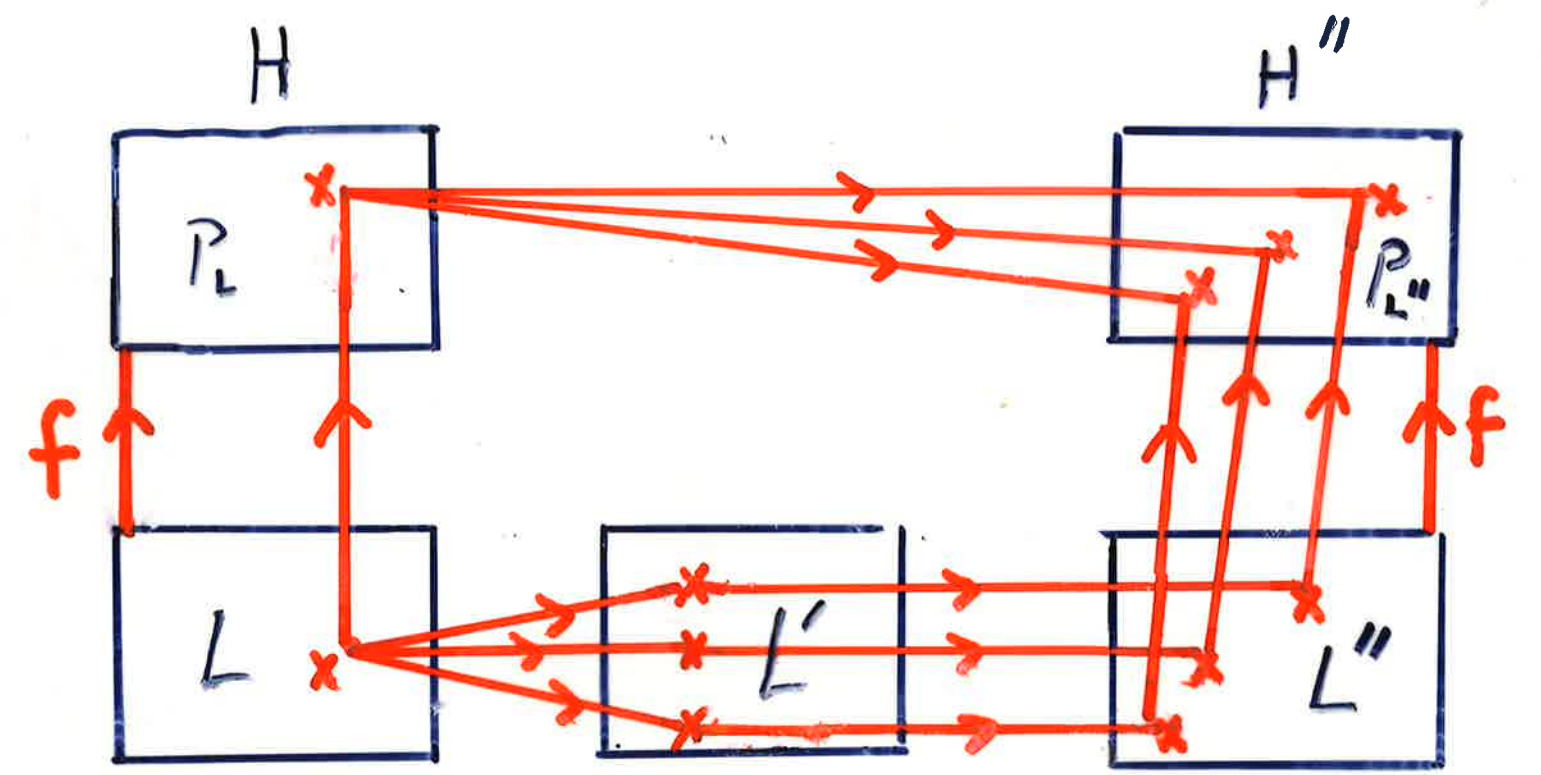
$$S_2 \equiv 0 \vee 0 \vee \dots = 0$$

According to Putnam

$$S_1 \text{ says } (\exists x) q(x) \wedge (\exists y) p(y)$$

$$S_2 \text{ says } (\exists x)(\exists y)[q(x) \wedge p(y)]$$

QUANTUM STATES AND PUTNAM STATES



Props
about
QM states

Props
about values
of observables

Props
about
Putnam
states